

Probability and Statistics

Mathematics Content Standards

This discipline is an introduction to the study of probability, interpretation of data, and fundamental statistical problem solving. Mastery of this academic content will provide students with a solid foundation in probability and facility in processing statistical information.

**Note:** The sample problems illustrate the standards and are written to help clarify them. Some problems are written in a form that can be used directly with students; others will need to be modified before they are used with students.

- 1.0

Students know the definition of the notion of *independent events* and can use the rules for addition, multiplication, and complementation to solve for probabilities of particular events in finite sample spaces.
- 2.0

Students know the definition of *conditional probability* and use it to solve for probabilities in finite sample spaces.  
  
A whole number between 1 and 30 is chosen at random. If the digits of the number that is chosen add up to 8, what is the probability that the number is greater than 12?
- 3.0

Students demonstrate an understanding of the notion of *discrete random variables* by using them to solve for the probabilities of outcomes, such as the probability of the occurrence of five heads in 14 coin tosses.
- 4.0

Students are familiar with the standard distributions (normal, binomial, and exponential) and can use them to solve for events in problems in which the distribution belongs to those families.
- 5.0

Students determine the mean and the standard deviation of a normally distributed random variable.
- 6.0

Students know the definitions of the *mean*, *median*, and *mode* of a distribution of data and can compute each in particular situations.
- 7.0

Students compute the variance and the standard deviation of a distribution of data.  
  
Find the mean and standard deviation of the following seven numbers:  
4   12   5   6   8   5   9  
  
Make up another list of seven numbers with the same mean and a smaller standard deviation. Make up another list of seven numbers with the same mean and a larger standard deviation. (ICAS 1997, 11)
- 8.0

Students organize and describe distributions of data by using a number of different methods, including frequency tables, histograms, standard line and bar graphs, stem-and-leaf displays, scatterplots, and box-and-whisker plots.

## Advanced Placement Probability and Statistics

## Mathematics Content Standards

### Chapter 2 Mathematics Content Standards

This discipline is a technical and in-depth extension of probability and statistics. In particular, mastery of academic content for advanced placement gives students the background to succeed in the *Advanced Placement* examination in the subject.

**1.0** Students solve probability problems with finite sample spaces by using the rules for addition, multiplication, and complementation for probability distributions and understand the simplifications that arise with independent events.

**2.0** Students know the definition of *conditional probability* and use it to solve for probabilities in finite sample spaces.

You have 5 coins in your pocket: 1 penny, 2 nickels, 1 dime, and 1 quarter. If you pull out 2 coins at random and they are collectively worth more than 10 cents, what is the probability that you pulled out a quarter?

**3.0** Students demonstrate an understanding of the notion of *discrete random variables* by using this concept to solve for the probabilities of outcomes, such as the probability of the occurrence of five or fewer heads in 14 coin tosses.

**4.0** Students understand the notion of a *continuous random variable* and can interpret the probability of an outcome as the area of a region under the graph of the probability density function associated with the random variable.

Consider a continuous random variable  $X$  whose possible values are numbers between 0 and 2 and whose probability density function is given by  $f(x) = 1 - \frac{1}{2}x$  for  $0 \leq x \leq 2$ . What is the probability that  $X > 1$ ?

**5.0** Students know the definition of the *mean of a discrete random variable* and can determine the mean for a particular discrete random variable.

**6.0** Students know the definition of the *variance of a discrete random variable* and can determine the variance for a particular discrete random variable.

**7.0** Students demonstrate an understanding of the standard distributions (normal, binomial, and exponential) and can use the distributions to solve for events in problems in which the distribution belongs to those families.

Suppose that  $X$  is a normally distributed random variable with mean  $m=0$ . If  $P(X < c) = \frac{2}{3}$ , find  $P(-c < X < c)$ .

**Note:** The sample problems illustrate the standards and are written to help clarify them. Some problems are written in a form that can be used directly with students; others will need to be modified before they are used with students.

Chapter 2  
Mathematics  
Content  
Standards

Advanced  
Placement  
Probability  
and Statistics

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| <b>8.0</b> | Students determine the mean and the standard deviation of a normally distributed random variable. |
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| <b>9.0</b> | Students know the central limit theorem and can use it to obtain approximations for probabilities in problems of finite sample spaces in which the probabilities are distributed binomially. |
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| <b>10.0</b> | Students know the definitions of the <i>mean</i> , <i>median</i> , and <i>mode of distribution</i> of data and can compute each of them in particular situations. |
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| <b>11.0</b> | Students compute the variance and the standard deviation of a distribution of data. |
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| <b>12.0</b> | Students find the line of best fit to a given distribution of data by using least squares regression. |
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| <b>13.0</b> | Students know what the <i>correlation coefficient of two variables</i> means and are familiar with the coefficient's properties. |
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| <b>14.0</b> | Students organize and describe distributions of data by using a number of different methods, including frequency tables, histograms, standard line graphs and bar graphs, stem-and-leaf displays, scatterplots, and box-and-whisker plots. |
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| <b>15.0</b> | Students are familiar with the notions of a statistic of a distribution of values, of the sampling distribution of a statistic, and of the variability of a statistic. |
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| <b>16.0</b> | Students know basic facts concerning the relation between the mean and the standard deviation of a sampling distribution and the mean and the standard deviation of the population distribution. |
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| <b>17.0</b> | Students determine confidence intervals for a simple random sample from a normal distribution of data and determine the sample size required for a desired margin of error. |
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| <b>18.0</b> | Students determine the <i>P</i> -value for a statistic for a simple random sample from a normal distribution. |
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| <b>19.0</b> | Students are familiar with the <i>chi</i> -square distribution and <i>chi</i> -square test and understand their uses. |
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